RED BELT in Alberta

J. K. Robins • J. R. Susut

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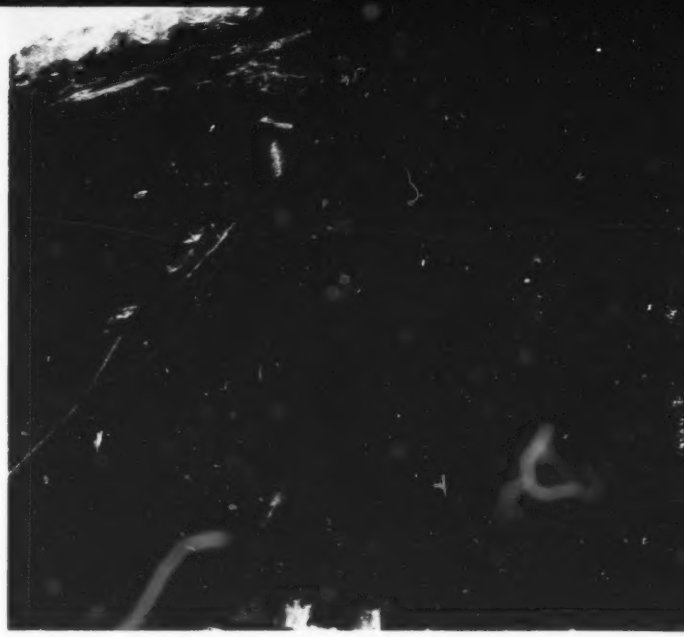
INTRODUCTION

In 1971, thousands of acres of lodgepole pine forest in the upper foothills of Alberta were killed by adverse weather conditions; a phenomenon commonly known as Red Belt. Approximately 14,000 acres of mature and immature lodgepole pine were destroyed in the Cadomin area alone. Annual field surveys carried out by the Canadian Forestry Service since 1948 indicate that Red Belt injury is common in western Alberta, but this was the first time that severe damage had occurred over such a large area or resulted in such complete tree mortality. Such extensive and severe damage undoubtedly occurred prior to 1948, but has been unrecorded, and will occur again in the future. There can be little doubt that Red Belt has a significant influence on the type and distribution of forest communities over large areas of the Rocky Mountain foothills.



Aerial view of Red Belt damage.

INJURY

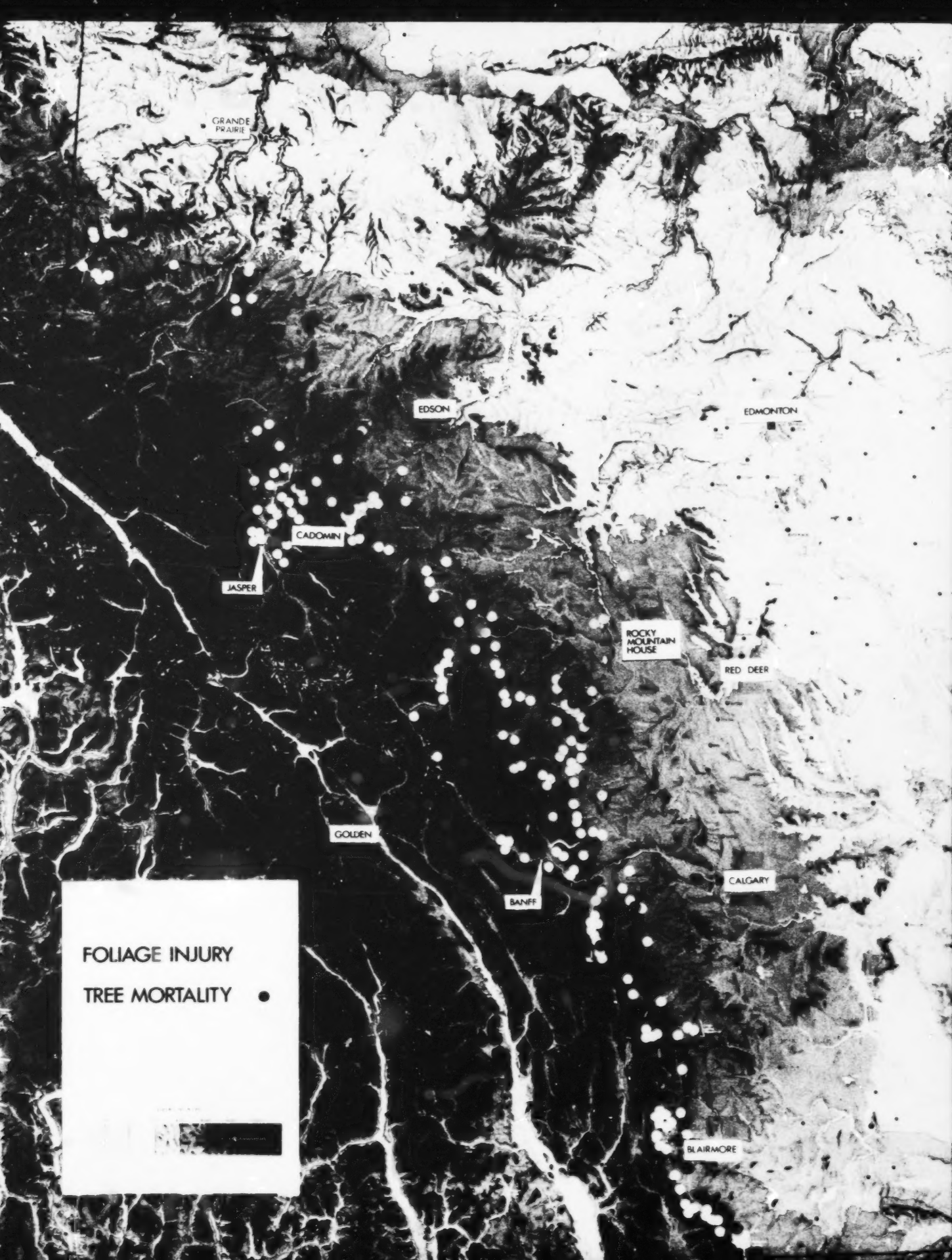
NATURE AND OCCURRENCE

Typically, Red Belt occurs during the late winter months or in early spring, although the term has been erroneously applied to frost damage occurring during the growing season. All native conifers may be affected, but lodgepole pine is the most susceptible. The most obvious damage is to the foliage which turns reddish-brown. The bark of stems and twigs may also be injured and buds killed.

Red Belt damage occurs most frequently in the middle and upper foothills and in the eastern portions of major mountain passes. South and west facing slopes are most affected. On long, steep slopes the damage may appear in a well-defined band but more commonly in patches, along ridges, slopes and occasionally in valley bottoms. In the southern part of the province, it is commonly found along the fringes of natural stand openings.

◀ *Lodgepole pine severely damaged by Red Belt. Note living branches which were protected by snow cover.*

Locations of Red Belt injury and tree mortality in Alberta, 1948-1971. ▶


GRANDE PRAIRIE
EDSON
EDMONTON
CADOMIN
JASPER
ROCKY MOUNTAIN HOUSE
RED DEER
GOLDEN
BANFF
CALGARY
BLAIRMORE
FOLIAGE INJURY
TREE MORTALITY

Red Belt injury near Jasper, late April 1974. Note the two "belts" separated by unaffected trees.

CAUSE

The cause of Red Belt injury is not definitely known. It is almost certainly climatological, although little directly related research has been undertaken to pinpoint the cause or to relate visual damage to impact. One explanation is that needles are desiccated by chinook winds while roots and stems are frozen. Another, strengthened by recent research into the cold-hardiness of plants, is that a rapid drop in temperature following above-freezing temperatures is the cause. The very abrupt margins of damaged areas indicate that the injury takes place during a very short period of time; tending to favor the latter theory. Whatever the cause, Red Belt is a natural phenomena over which there is not likely to be any control. More precise knowledge as to the cause might prove valuable in its application to a related problem, the winter browning of ornamental conifers.

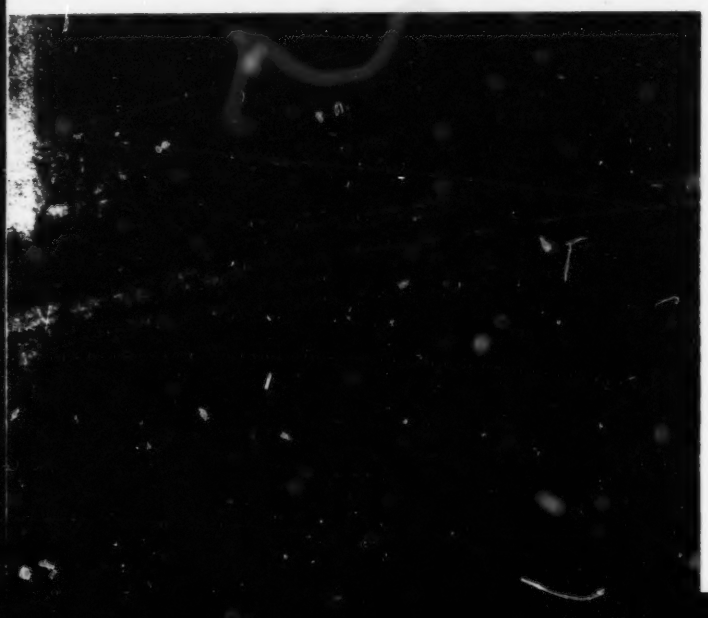
ASSESSMENT AND MAPPING

Observations of damaged pine stands in the Cadomin area have shown that lodgepole will not survive complete loss of foliage. If buds are not killed, some shoot elongation may occur using stored resources but no new buds will form. However, if as little as 5-10 per cent green foliage remains, new buds will form and the tree will probably survive the injury. This is particularly evident where younger trees have uninjured branches below snow level and survived complete loss of exposed foliage.

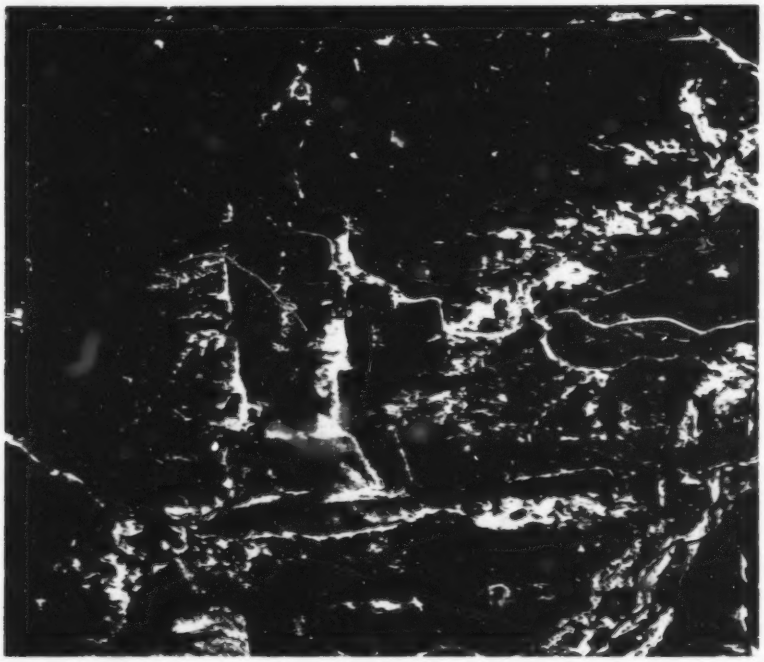
Trees weakened by Red Belt may survive the original injury, yet succumb to secondary agents within a short time. Root diseases, especially *Armillaria mellea* are present in most lodgepole pine stands and soon attack weakened trees. Bark beetles attack less quickly as their populations require time to build up. Any impact assessment of Red Belt damage should take these secondary agents into account.

The most practical method of delineating damage is from the air by sketch mapping or by the use of photography. Infrared false color is recommended, as haze problems are virtually eliminated and the contrast between damaged and healthy trees is enhanced. On properly exposed film, live lodgepole pine appear magenta, bare dead trees blue-green, and yellowed foliage yellow. A 9.5 in. x 9.5 in. format at a scale of 1:30,000 is satisfactory for mapping extensive damage. Damage to individual trees can be readily diagnosed on 70 mm. false color photography at a scale of 1:2,200. Either method requires good ground checks.

Red Belt damage along fringes of natural stand openings in southern Alberta.

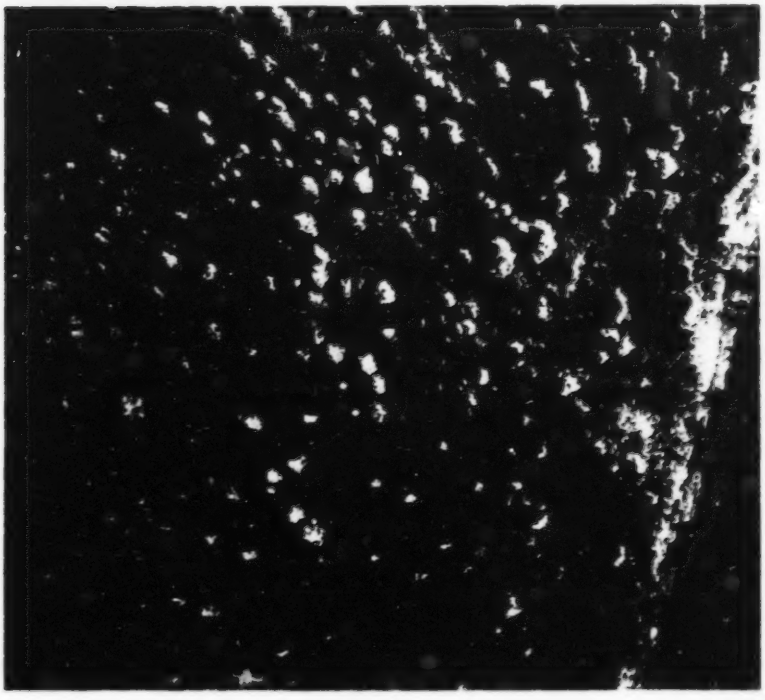


Extensive Red Belt damage on a south-west facing ridge near Cadomin. Note healthy Engelmann spruce in right foreground.



1:30,000

FALSE COLOR small-scale aerial photograph showing Red Belt injury. Damaged stands appear bluish; healthy stands magenta.



Dead lodgepole pine (bluish)

Healthy Engelmann spruce (magenta)

Damaged lodgepole pine (yellowish)

1:1,000

FALSE COLOR large-scale aerial photograph showing Red Belt injury.

IMPACT

Little attention has been given to the impact of Red Belt on forest communities because affected areas are generally small, damage inflicted light, and subsequent effects so gradual that they usually escape notice. However, when extensive severe damage occurs, major changes follow, affecting not only the vegetation but the economic and aesthetic values of the forest over a long period. Management decisions concerning these areas should take into account the probable succession of plant species under managed and natural conditions, the feasibility of timber salvage, the potential effects of increased fire hazards on adjacent undamaged stands, and the impact on wildlife and aesthetic values.

VEGETATIVE SUCCESSION

Where pure lodgepole pine stands have been killed, it is probable that the deep, undisturbed duff layer, and competition from existing herbaceous vegetation, will prevent early replacement of the species. There will be a release of the ground cover following the loss of the canopy, then a gradual replacement of most plants by willow and alder on moist sites, and grasses and annuals on drier ones. Less susceptible spruce or fir, when present in these stands, may survive to give some coniferous cover. Poplar may colonize some areas. Quick replacement of damaged areas with lodgepole pine or other conifers requires treatments such as timber salvage, scarification or controlled burning, followed, if necessary, by direct seeding or planting.

Many exposed slopes along the foothills do not support conifers, being covered by low shrubs, grasses or stunted poplars. On forested slopes, natural openings are growing in size as evidenced by dead conifers around the periphery. Frequent Red Belt damage may be the reason for the lack of, or decrease in coniferous cover in these areas.

While the extensive mortality that occurred in the Cadomin area in 1971 may be unique, it would appear that in certain situations coniferous stands located on susceptible sites may have originated following Red Belt damage, rather than after fire as is often assumed.

TIMBER SALVAGE

Where extensive mortality caused by Red Belt occurs in merchantable timber and salvage is planned, action within two years is essential. During the first two years following death, the trees contain an excess of moisture, due to the absence of transpiring needles and are therefore not subject to attack by bark beetles and wood borers, nor is there checking. Root diseases, however, invade immediately. By the third year the stems dehydrate to a point that favors attack by ambrosia beetles and accompanying fungi; the bark begins to sluff off; checking commences. Timber salvage, if carried out, will significantly affect vegetative succession and fire hazard.

FIRE HAZARD

Fire hazard to adjacent unaffected stands depends on the severity of Red Belt damage. When complete stands are killed, dead needles on the trees make them extremely flammable, and since damage is usually on ridges, there is an increased ignition risk due to possible lightning strikes. This danger prevails for the first summer following injury. Most needles are shed by the second summer resulting in a heavy ground fuel load which remains long after the needles have been overgrown by herbaceous vegetation. Stems and branches do not dry out for about two years but from the third year onward, large volumes of standing dry material create a high hazard. Because of the rapid entry of root rots, Red Belt-killed trees are soon subject to windthrow. Few of these trees will get the ground contact required for rapid decomposition; this hazardous condition will last for many years. Where tree mortality does not occur, the degree of danger depends on the volume of dead needles, either on the trees or the ground; however, fire risk returns to normal in about 3 or 4 years. Wildfires, or prescribed burning of severely damaged stands 1-3 years following complete mortality could substantially improve the habitat for wildlife.

Complete mortality of this mature lodgepole overstorey will significantly affect vegetative succession and fire hazard, wildlife and aesthetic values.

WILDLIFE

A significant factor limiting ungulate populations in the Alberta foothills is the availability of winter food. Southwest facing slopes with their cover of palatable shrubs, grasses and forbs frequently free of snow, make ideal winter range for most of Alberta's big game species. It would appear that Red Belt plays a significant role in the creation and maintenance of these openings. Natural plant succession on the 14,000 acres of lodgepole pine forest killed by Red Belt in the Cadomin area will undoutedly increase the capacity of the area to support moose, deer and elk.

Mountain sheep

AESTHETIC VALUES

While Red Belt damage does create an unsightly condition, most damage is out of sight or so remote as to have little effect on visible scenic quality. When significant impairment does occur the cost of treatment will have to be balanced against the benefit to be gained. With increased awareness of the natural environment, the public may accept Red Belt damage for what it is, a natural phenomenon.

SELECTED READING

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FRONTISPIECE

Red Belt-damaged lodgepole pine near Cadomin, Alberta. Photographed in the autumn of 1971, most trees have since died.